

What is claimed is:

1 1. A method of predicting failure in a process having associated metrics and a plurality
2 of operational variables, the method comprising the steps of:

3 using non-linear regression to predict values for a first set of operational variables
4 based on two or more prior values thereof;

5 using non-linear regression to predict a plurality of process metric values based on
6 the first set of predicted values and prior values of two or more operational variables; and

7 determining a likelihood of a process failure based on one or more of the
8 predicted process metric values.

1 2. The method of claim 1, wherein the first set of predicted values is predicted by
2 applying a separate non-linear regression model to each of the process operational variables,
3 wherein each of the separate non-linear regression models has been trained in the relationship
4 between a single process operational variable and prior values of two or more process
5 operational variables.

1 3. The method of claim 2, further comprising repeating the steps of the method for at
2 least one sub-process of the process.

1 4. The method of claim 2, further comprising repeating the steps of the method for a
2 higher-level process comprising the process.

1 5. A method of predicting failure in a process having a plurality of operational variables
2 associated therewith, the method comprising the steps of:

3 using non-linear regression to predict values at a first time for a first set of
4 operational variables based on two or more prior values thereof;

5 using non-linear regression to predict values at a second time for a second set of
6 operational variables based on two or more prior values thereof; and

7 determining a likelihood of a process failure based on one or more of the
8 predicted values for the process operational variables at the first time and the second
9 time.

1 6. The method of claim 5, wherein the second set of process operational variables are at
2 least a subset of the first set of process operational variables.

1 7. The method of claim 5 further comprising using non-linear regression to predict
2 values at a third time for a third set of operational variables based on two or more prior
3 values thereof.

1 8. The method of claim 7 further comprising using non-linear regression to predict
2 values at a fourth time for a fourth set of operational variables based on two or more prior
3 values thereof.

1 9. A method of predicting the need for maintenance activities for a process having a
2 plurality of operational variables associated therewith, the method comprising the steps of:

3 using non-linear regression to predict values at a first time for a first set of
4 operational variables based on two or more prior values thereof;

5 using non-linear regression to predict values at a second time for a second set of
6 operational variables based on two or more prior values thereof; and

7 determining the need for a maintenance action based at least in part on a
8 comparison of the first set of predicted values with the second set of predicted values.

1 10. The method of claim 9 wherein the determining step is also based on process yield
2 metrics.

1 11. The method of claim 9 wherein the step of predicting the second set of values at the
2 second time is also based on process yield metrics.

1 12. The method of claim 9 wherein the first set of predicted values at the first time is
2 constrained by cost data.

1 13. The method of claim 9 wherein the second set of predicted values at the second time
2 is constrained by cost data.

1 14. A system for predicting events of a process having associated operational variables,
2 the system comprising:
3 (a) a process monitor for monitoring operational variables; and
4 (b) a data processing device for receiving, from the process monitor, data indicative
5 of values of the operational variables, and predicting events based on (i) a relationship
6 between a first set of predicted values for a first set of process operational variables and two
7 or more prior process operational variable values thereof, (ii) a relationship between a second
8 set of predicted values for a second set of process operational variables and two or more prior
9 process operational variable values thereof, and (iii) a relationship between a predicted
10 process event, the first set of predicted values, and the second set of predicted values.

1 15. The system of claim 14 wherein the process event is a process failure.

1 16. The system of claim 14 wherein the process event is a maintenance activity.

1 17. A system for predicting failure in a process having associated operational variables,
2 the system comprising:
3 (a) a process monitor for monitoring operational variables; and
4 (b) a data processing device for receiving, from the process monitor, data indicative
5 of values of the operational variables, and predicting process failure based on (i) a
6 relationship between a first set of predicted values at a first time for a first set of process
7 operational variables and two or more prior process operational variable values thereof, (ii) a
8 relationship between a second set of predicted values at a second time for a second set of
9 process operational variables and two or more prior process operational variable values
10 thereof, and (iii) a relationship between a process failure, the first set of predicted values at a
11 first time, and the second set of predicted values at a second time.

1 18. A system for predicting the need for maintenance activities in a process having
2 associated operational variables and process metrics, the system comprising:
3 (a) a process monitor for monitoring operational variables; and
4 (b) a data processing device for receiving, from the process monitor, data indicative
5 of values of the operational variables, and predicting process failure based on (i) a
6 relationship between a first set of predicted values at a first time for a first set of process
7 operational variables and two or more prior process operational variable values thereof, (ii) a
8 relationship between a second set of predicted values at a second time for a second set of
9 process operational variables and two or more prior process operational variable values
10 thereof, and (iii) a relationship between a need for a maintenance activity, the first set of
11 predicted values at a first time, and the second set of predicted values at a second time.

1 19. The system of claim 18 further comprising a process controller, responsive to the
2 data processing device, for performing maintenance activities based on the predicted process
3 event.

- 1 20. The system of claim 18 further comprising a data storage device for storing one or
- 2 more of maintenance activity records and maintenance activity costs.